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Docket Management System
Docket No. FAA-2002-14081
Department of Transportation
Room Plaza 401
400 Seventh Street, SW.
Washington, DC 20590-0001

Subject: Comments to FAA Notice of Proposed Rulemaking, Transponder Continuous Operations, Docket No. FAA-2002-14081

Dear Sir:

Enclosed are comments from Boeing Commercial Airplanes concerning the subject Notice of Proposed Rulemaking. We hope these comments are considered in the interest of providing clarification to current and future type design applicants in providing for Transponder Continuous Operations for future transport category airplane designs.

Please direct any comments or questions to Ms. Jill DeMarco of this office at (425) 965-2015.

Sincerely,

Captain Chet Ekstrand
Vice President, Regulatory Affairs
Boeing Commercial Airplanes

Boeing Commercial Airplanes
Comments on NPRM Notice 03-02, Docket No. FAA-2002-14081
"Transponder Continuous Operation"

Summary of Comments

Boeing Commercial Airplanes shares the interest of the Federal Aviation Administration (FAA) in addressing Aviation Safety and Security. Boeing has fully supported the activities associated with this important topic through participation in the FAA-Industry Transponder Task Force formed under the sponsorship of the Air Transport Association (ATA). Our close involvement with this task force, combined with further analysis and coordination within the industry, convinces us that promulgating the rules, as proposed, would impose an unforeseen and undue cost burden on the airlines without a commensurate enhancement to public security. Boeing maintains that the NRPM has significantly understated industry costs associated with transponder upgrading, airplane hardware retrofitting, and associated airplane downtime, when all various combinations, generations, and permutations of transponder systems are considered.

As an alternative, Boeing envisions and suggests a more layered approach to security assurance whereby systems and/or airframe features, while independent, collectively provide a secure flight deck environment. These layers include:

- enhanced airport security,
- secure airplane flight deck doors (already mandated), and
- other security enhancements being adopted or under consideration.

Boeing contends that these layered measures have already achieved a significant improvement to aviation security.

The value of any additional enhancement to security afforded by transponder system upgrades like those proposed in this NPRM is unclear and considered overly burdensome to the airline industry. For additional security enhancement measures, Boeing recommends evaluation, and possible implementation, of features that enhance security while simultaneously benefiting general Air Traffic Management (ATM) needs. A means of downlinking airplane position, status, and/or intent to the ATC facility or handler via non-transponder based systems is an example of an ATM enhancement, which should only be made when cost-effective for the entire industry.

If the FAA concludes that the upgrade proposed by this NPRM is still warranted, Boeing believes that the overarching need to ensure continuous transponder operations, via a single flight crew action with disable protection, has been alleviated by the layered security measures already implemented and the intent of this NPRM can be achieved via "less stringent" means, such as software-only revisions to the applicable on-board ATC Transponders.

Recommended Changes to the Text of the NPRM

Should the FAA deem the intent of this NPRM still necessary, Boeing proposes the following changes to §121.346, which is predicated on prior compliance with SFAR 92-4 and associated promulgated rules, and allows for, at minimum, software upgrading of the ATC transponders to ensure continued "squawking" of code 7500 when activated by the flight crew while ensuring that "more complex" modifications are still allowed as approved by the administrator.

§121.346 ATC transponder operation.

(a) After March ~~29~~ ***28***, ~~2005~~ ***2008***, no person may operate an airplane unless that airplane has the capability to allow each flight crewmember to ~~quickly~~ activate the ATC transponder Mode 3A beacon code ''7500'' through a ~~single action~~ ***control panel code selection followed by validating action, or by alternative means as approved by the*** administrator ~~that includes protection from inadvertent activation~~.

(b) Upon activation of the ATC transponder Mode 3A beacon code ***"7500"***, as described in paragraph (a) of this section:

(1) The ATC transponder must ~~continue to~~ continuously report the airplane's altitude ***without regard to additional control panel code inputs or other control panel selections; and***

~~(2) There must be a visual indication to the flight crew that the activation has occurred; and~~

(~~3~~***2***) A person onboard that airplane must not be able~~, by reasonable means,~~ to ***alter or*** disable the ~~transponder or change its~~ ***transmitting*** code during the remainder of the flight. In this case, the pilot-in-command need not comply with the requirements of §91.217(a) of this chapter.

1.0 Rationale

The following discussion is the basis for Boeing's "Summary of Comments" and "Recommended Changes to the text of the NPRM."

2.0 General Requirements of Proposed Rule

With respect to technical implementation, the proposed rule, as written, is envisioned to require:

1. Transponder part number roll to incorporate functionality,
2. Activation switches,
3. Visual annunciation such as a lighted switch,
4. EE-Bay circuit breakers and power relays for continuous power,
5. Associated wiring, and

6. Documentation changes (e.g., Airplane Flight Manual, Maintenance Manuals, Operations Manuals, Flight Crew Training Manuals, etc.).

With respect to technical implementation, the proposed rule, as revised in "Recommended Changes to the NPRM" by Boeing, is envisioned to require, at minimum (while allowing for more complex installations (as noted items 1 – 6) above):

1. Transponder part number roll to incorporate functionality, and
2. Documentation changes (e.g. Airplane Flight Manual, Maintenance Manuals, Operations Manuals, Flight Crew Training Manuals, etc.).

3.0 Fleet Composition

The proposed rule could potentially apply to two major classes of transponders. The first, ARINC 718-based Mode-S transponders, are required for TCAS and compose a substantial majority of the installed transponder base (approximately 90%) in the US fleet. The second, Mode-C transponders of the ARINC 572 (and possibly older ARINC 532) variety, cannot work with on-board TCAS units and are not being installed in current production airplanes manufactured by Boeing. However, some Part 121 operators of older generation airplane may still utilize these transponders as an alternate or backup transponder in the event that the Mode S transponder fails.

Since FAR Part 121 operators, by mandate, have at least one Mode S transponder, the US fleet is primarily composed of airplanes with:

1. Dual Mode S (both ARINC 718 XPDRs) installations,
2. Hybrid Mode S/Mode C (one ARINC 718 / one ARINC 572 XPDRs) installations

As a consequence, the cost and schedule impacts of the rule, as currently proposed, will be partially driven by this fleet composition. Boeing has been delivering airplanes with Mode-S transponders since approximately 1988, and we estimate that a major portion of the industry effort to address the transponder continuous operation requirement will be focused on solutions with dual Mode-S installations. While the solutions for hybrid installations will be in general accordance with the proposed requirements, they will still require a separate design solution and associated certification effort along with more complex wiring/installation guidance. Therefore, all efforts expended to mitigate the cost and schedule impact of the proposed rule could have a far-reaching and burdensome impact on the industry.

4.0 Cost Impact

The fallout from the September 11th, 2001, terrorist events has had a tremendous financial impact on the airline industry. Therefore, it is imperative that all industry stakeholders consider appropriate and acceptable means of implementing the proposed rule that mitigates undue cost burden to the airline industry. While an industry cost assessment was included in the NPRM, a substantial variance with the actual costs is expected to be incurred with respect to specific implementations. Items 4.1 through 4.6, below, contain a discussion of the cost aspects of the proposed rule that augments the data collected during the FAA-industry task force activities.

4.1 Transponder P/N Roll: Unit Cost

While some of the transponder suppliers, as noted in the proposed rule, have reported approximately $3,000 for transponder upgrades, others have reported figures upwards of $8,000 for the incorporation of continuous operational functions resident to the transponders. This variation is due to the fact that different suppliers have different design implementations on which the new requirements have a “high” or “low” design effort and, consequently, higher or lower associated costs.

In general, it is expected that the transponder continuous operational feature is simpler to implement on newer generation transponders than it is on older generation transponders due to software loadability features. For example, the software upload option discussed in the NPRM is available only on fairly new transponders and is not a universal feature available in all transponders. Based on the foregoing and considering the full range of transponders, the unit cost estimates are expected to be higher than the estimates reported in the NPRM.

4.2 Transponder P/N Roll: Dual Installation Cost

Since the substantial majority of the US fleet is equipped with dual transponders, both transponders should be capable of the continuous operational functionality. Consequently, cost considerations for dual equipage should be considered in the NPRM rather than single equipage. Only considering continuous operational capability on one of the two transponders is undesirable due to the introduction of different part numbers associated with transponder functionality and the associated logistical costs of managing different part numbers to the airlines. Such alternatives would also hamper maintenance requirements, MEL requirements, and the design & operational symmetry of the left and right transponder systems.

4.3 Aircraft Installation Upgrade: Costs for Transponder Continuous Operational Mode Activation Switches And Visual Annunciation

Anticipated airplane installation upgrades for transponder continuous operation “activation” and “visual annunciation” is primarily focused in the flight deck and can be complex when integrated into the existing flight deck environment. Also, these upgrades are expected to impact crew operations and require human factors considerations. Since SFAR 92-4/§121.31 and other promulgated rules have already mandated enhanced security flight deck doors, the requirement for a single crew action to quickly activate the continuous operational mode may be alleviated because of added protection against surprise intrusion. Thus if still deemed necessary, transponder software upgrades allowing for crew selection of code 7500 via the standard ATC control panel input should satisfy the intended purpose of the NPRM.

4.4 Aircraft Installation Upgrade: Costs for EE-Bay Circuit Breakers and Power Relays for Continuous Power

Anticipated airplane installation upgrades for continuous or uninterruptible power are primarily focused in the EE-bay. While the cost impact for this type of upgrade is typically less than flight deck related upgrades, alternatives that may achieve the same goal at less cost should also be explored. Further, the potential to incorporate non-transponder based communications protocols offered by future ATM/ATC and CPDLC advances that enable transmission of airplane status, position, and/or intent may offer

more cost-effective means of ensuring continued airplane status reporting to the appropriate ATC facility or handler.

4.5 Costs for Older Aircraft

Older airplanes with hybrid installations (Hybrid=Mode S/Mode C (one ARINC 718 / one ARINC 572 XPDRs)) and airplanes that are due to be phased out in the near term may incur significant costs since the potential design solution cannot be spread over a large number of airplanes and since in-service lifetime after the modification is believed to be short. While costs for upgrading older airplanes may not make up a significant part of the total industry cost, the cost can represent a significant burden to the specific operator and should be considered in the cost analysis.

Unfortunately, Boeing cannot provide a good estimate for this aspect of the cost analysis since "hybridization" occurred in-service with the assistance of third-party modification shops and STC providers. However, absent any unusual configuration attributes, the cost impact for such aircraft should be, roughly, (1) the cost for dual mode-S transponder equipage or upgrading, plus (2) the cost for transponder continuous operation upgrading (per this NPRM).

4.6 Pilot Training/Operational costs

The full cost of implementation must also consider airline flight crew training. Training equipment such as simulators will require upgrades as well as airplanes. Development of new procedures will impact training documents, Flight Crew Training Manuals, and airplane Operations Manuals.

5.0 Schedule

When the full complexity of the proposed rule, as written without adopting Boeing's recommendations, is considered across all potential installations, the proposed compliance date of March 2005 is quite aggressive and will likely incur additional schedule related costs. In terms of schedule, the most efficient way of implementing the change, as written, would be to dovetail it with another required change or to incorporate it in-sequence with a C- or D-check. While Boeing strongly recommends changes to the NPRM to allow for compliance via less stringent methods, should these recommendations not be adopted, Boeing suggests that additional time be granted to allow for the hardware upgrading.

Boeing appreciates the FAA's efforts to consider having the compliance schedule synchronized with the TAWS compliance date of March 2005. Initially, Boeing had also hoped to include the associated transponder change along with the Elementary Surveillance changes required for Europe in the 2003-2005 timeframe in order to mitigate costs. Unfortunately, the current schedule no longer accommodates such an arrangement because implementation of Elementary Surveillance has already begun.

Therefore, since (a) the possibility of alignment with a current TAWS requirement is not achievable and (b) the "first line of defense" -– enhanced security flight deck doors –- have already been incorporated, it would be advantageous to allow, at a minimum, a four-year compliance time for complex upgrades. This will provide one year after the final rule (approximately 2004) for design solutions to be developed and certified and three years (2005-2008) for the airlines to incorporate the change. Additionally, this also

provides an opportunity to align the change with the end of the proposed transition for European Enhanced Surveillance.

The benefits of such a schedule are twofold. First, it gives all airlines an opportunity to add the required changes during C-checks in a non-disruptive manner. Second, since other regulators will likely follow the FAA with their own version of transponder continuous operational requirements, this schedule will give an opportunity to rationalize international standards prior to implementation.

6.0 Discussion of Alternative Proposals

Throughout the deliberative phases of the RRT and the ATA-led FAA-industry task force pursuant to transponder security, Boeing has had an opportunity to evaluate possible alternatives and to consider airline customer feedback. This section conveys some of the results of this effort to the FAA.

6.1 Phased Approach

Security enhancements for aircraft are likely to continue to evolve and improve over the coming years. What is being developed today for Mode 3A/C transponders can potentially encompass the whole gamut of integrated surveillance and communications capabilities utilizing UAT, VHF, and FANS, or ATN-based functions. If future non-transponder-based enhancements can accomplish equivalent tasks and comply with the intent of the NPRM, a layered approach is likely to offer a more cost-effective and preferred solution.

6.2 Continuous Operation

The underlying goal of the proposed rule involves the ability of the ATC facility to track airplanes; that is, continuous transponder operation that cannot be “reasonably” interrupted once activated. At its core, this capability requires either alternate power and switching circuitry away from the flight deck, or the installation of ‘collarless’ circuit breakers and disabling of the standby mode and code changes upon activation.

Disabling of the standby feature, once code 7500 is latched, is solvable and can be addressed via appropriate transponder software modification. With respect to power isolation to protect against disabling, in the interest of (1) mitigating the near-term cost impact, (2) addressing suitability of alternate power sources which may impact flight critical system needs, and (3) allowing for a “layered approach” using future non-transponder-based communications protocols, Boeing recommends that the FAA consider embracing a software-only transponder upgrade if still deemed necessary.

6.3 Activation

While continuous transponder operation is perceived as the underlying goal of the NPRM, simple and quick activation of the feature is of fundamental concern. The requirement for a “quick activation,” however, is considered to be somewhat ambiguous. Quickness can be measured in absolute terms, such as, provided by a single action switch. Alternatively, it can also be measured in relative terms if, for example, the ingress delay provided by enhanced security doors can be credited. In terms of probability of successful activation, dialing code 7500 via the flight deck control panel in a configuration with enhanced security doors might be preferable to a remotely-located and seldom-used switch. Further, single action activation may carry risk of inadvertent

actuation. Boeing recommends the rule provide for other means of activation, such as dialing code 7500 and pressing the IDENT button twice or similar action. Multiple action activation methods will help ensure that deliberate action by the flight crew is required. Further, flight crews may be somewhat reluctant to activate hijack mode due to the risk of military action or interdiction.

Should the FAA also find that the probability of a successful activation is sufficiently improved by the enhanced security doors, we recommend that the "single action" (switch) requirement can be relaxed to allow dialed activation, followed by validating action (such as IDENT) via the control panel for airplanes requiring equipage with enhanced security doors should the FAA opt to pursue this NPRM further.

6.4 Continuous Alerting of Code 7500

Due to issues associated with inadvertent activation, continuous transponder operation that cannot be changed or altered in-flight is probably the function that has received the greatest attention from flight crews. Some airlines and their flight crews have raised the point that there are no operational procedures on how to handle such inadvertent activations. More importantly, there are also concerns that the heightened response by authorities –- for example, in countries that have less disciplined/organized forces –- may result in a catastrophic response to inadvertent activation.

While the transponder operation can be designed to allow flight crews a means of "canceling" the 7500 altering code upon inadvertent activation, the proposed rule as written doesn't provide for this "canceling" functionality. Rather, the continuous operation can only be canceled via resetting once the airplane is on the ground. To address inadvertent activation issues, Boeing envisions the introduction of robust Air Traffic procedures whereby the ATC facility or handler receiving the alert code shall continuously track the movements of the airplane and attempt to establish contact with the flight crew to ascertain the validity of the alerting transmission.

6.5 Annunciation

In general, current transponder system annunciations to the flight crew are limited to a control panel fault light, and in some models, an EICAS message. The prevailing design has ATC monitoring and alerting the flight crew to wrong "Mode A" encoding or inaccurate altitude reporting. The control panel is also installed in the flight deck in such a manner that all control settings can be read by both pilots. Therefore, relative to an already sparse annunciation scheme, adding a separate transponder continuous operational mode annunciation is not a trivial or insignificant task. Further, even subtle indication could prompt an educated flight deck intruder to attack the flight crew. Given this, Boeing recommends that visual indication of activation should not be mandated.

At present, continuing with the practice of the ATC facility alerting the flight crew of code 7500 activation is considered appropriate. The main reason is, as currently defined in DO-181C Change 1, Code 7500 can be activated on the ground and therefore can be detected by ATC prior to departure. Consequently, the case mentioned in the NPRM where an erroneously initiated code 7500 was detected on takeoff is unlikely to happen in a well-designed transponder installation (The A/C mentioned in the NPRM did not have a DO-181C Change 1 transponder. The squawk code was resident in an alternate control panel and the A/C did not transmit 7500 until airborne).

However, Boeing recognizes that certain operators may elect to pursue or incorporate visual flight deck indication of Code 7500 activation based upon unique operational preferences. Possible visual indicators could involve “fault light” flashing or EICAS message (such as "XPDR CODE OVRD") annunciations. Based on the foregoing and provided the FAA still seeks to mandate transponder upgrading, Boeing recommends that any ruling adopt the software-only transponder upgrading concept while allowing for flight deck visual annunciation of squawk code activation on an elective basis as approved by the Administrator.